Remarks

Upon entry of the instant Amendment, claims 1-22 will be pending in the application for the Examiner's review and consideration. In the instant Amendment, claims 23-28 have been canceled, without prejudice, and claims 1-3, 8-11, 15-17, and 21 have been amended. Claims 1-3, 8-11, 15-17 and 21 have been amended to incorporate the limitation of the canceled claims 23, 25, and 27. Support for the amendment is found, for example, at paragraph [0108] and Table 1, e.g. steel D of the published application. Accordingly, no new matter has been added.

Claim rejection under 35 U.S.C. §103

Claims 1-28 are rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 4,591,396 to Mazuda, et al. ("US '396") in view of CA 2,429,439 ("CA '439") for the reasons set forth on pages 2-5 of the Office Action. The rejection is rendered moot as to claims 23-28 by cancellation of the claims. However, the subject matter of the cancelled claims 23, 25, and 27 has been incorporated into the remaining claims.

While not acquiescing to Examiner's rejection, the claims have been amended herein to expedite prosecution of the current application. In particular, claims 1-3, 8-11, 15-17, and 21 have been amended to recite that the steel plate for ultra-high-strength linepipe having excellent low-temperature toughness has not more than 0.28 mass% of Si.

According to the present invention, in addition to keeping the individual alloy elements in the steel plate within the claimed range, it is also necessary to maintain the P value, which is an index of hardenability, in the range of $2.5 \leq P \leq 4.0$. This is necessary for securing the balance between strength and low-temperature targeted by the ultra-high-strength steel plate and linepipe. The P value increases when the amounts of the alloying elements increase for improving hardenability. Each coefficient in an alloying element is determined based on its contribution to hardenability.

Furthermore, the ultra-high-strength linepipes of the present invention are developed by having a circumferential tensile strength (TS-C) of not lower than 900 MPa (equivalent to API X120) and a reduced longitudinal tensile strength (TS-L). In the present application, the relationship between the microstructure of steel plate for ultra-high-strength linepipe and the strength of steel plate in the directions of rolling and transverse was investigated, the present inventors discovered that longitudinal tensile strength (tensile strength longitudinal to the

rolling direction) of steel plate can be effectively reduced by transforming the microstructure thereof into a degenerate upper bainite structure. Degenerate upper bainite structure is defined by the present application as having a lath structure characteristic of low-temperature transformation structures and forms carbides and martensite-austenite (MA) constituents of the second phase coarser than those in lower bainite. While degenerate upper bainite can be distinguished from lower bainite by scanning electron microscopy, it is difficult to determine the quantitative proportion therebetween by microstructural photograph. In this invention, therefore, degenerate upper bainite and lower bainite are distinguished by comparing Vickers hardness by taking advantage of the fact that degenerate upper bainite is not as hard as lower bainite.

The steel of the present invention consists primarily of degenerate upper bainite in which degenerate upper bainite accounts for more than approximately 70% and the ratio (Hv-ave_p)/(Hv-M) between the average Vickers hardness Hv-ave_p in the direction of thickness and the martensitic hardness Hv-M is between 0.8 and 0.9 and the TS-Tp is between 880 MPa and 1080 Mpa. According to the present invention, the longitudinal tensile strength (TS-Lp) is smaller than the transverse tensile strength (TS-Tp), for instance, the TS-Lp is not greater than 0.95 times the TS-Tp. Additionally, it is preferable to keep the yield ratio in the rolling direction of steel plate (YS-Lp)/(TS-Lp) not greater than 0.80, where YS-Lp is the 0.2% offset yield strength of steel plate and TS-Lp is the tensile strength thereof.

US '396 relates to a method of producing a steel having high strength, high toughness and excellent weldability, by a combination of chemical composition of the steel and a specific condition for heating and rolling, as well as cooling after the rolling.

US '396 discloses that the microstructure of the steel obtained from US '396 after cooling contains fine upper bainite or a duplex structure of fine upper bainite and less than 20% of ferrite (see, *e.g.*, US '396 at col. 4, ll. 12-15; col. 5, ll. 42-57), which is quite different from the present steel pipe having a microstructure composed of primarily degenerate upper bainite of more than 70%. It is shown that there is a difference between an upper bainite structure and a degenerate upper bainite structure. As described in the present application and in two technical publications (*see* H.K.D.H. Bhadeshia, "Bainite in Steels, Transformations, Microstructure and Properties" (The University Press, Cambridge, 2001), second edition, page 190; and "Metals Handbook, Properties and Selection: Irons, Steels, and High-Performance Alloys" (ASM Int'l, 1990), tenth edition, volume 1, page 129, both publications submitted in the Supplemental Information Disclosure Statement filed

concurrently herewith), a degenerate upper bainite structure is different from an upper bainite structure in that the degenerate upper bainite contains MA (martensite-austenite) constituents between the lath structure, whereas the upper bainite structure contains cementite between the lath structure (*see* also, Figure 3 of the specification which shows a schematic illustration of a lower bainite, degenerate upper bainite and granular bainite structure). Therefore, US '396 does not teach or suggest obtaining a degenerate upper bainite microstructure as described in the present invention.

In addition, US '396 does not teach or suggest developing a steel having a circumferential tensile strength (TS-C) of not lower than 900 MPa by lowering the tensile strength in the longitudinal direction, and that the longitudinal tensile strength TS-Lp is not greater than 0.95 times the transverse tensile strength TS-Tp, and the yield ratio in the direction of rolling (YS-Lp/TS-Lp) is not greater than 0.8, as claimed.

Additionally, US '396 does not teach or suggest the P-value as defined in the present application. As acknowledged by the Examiner in the Office Action (on page 3) dated September 9, 2009, steel Example No. 2 in Table 1 of US '396, when calculated, has a P-value = 1.57 outside the claimed P-value range of 2.5 and 4.0. Additionally, the P values for all of the steels exemplified in US '396 have been calculated and found to be below 2.5, which is outside the claimed P-value range as defined in the present application.

According to the present invention, the reason the lower limit of the P value was set at 2.5 is to obtain excellent low-temperature toughness by keeping the circumferential tensile strength of linepipe at 900 MPa or above. The reason the upper limit of the P value was set at 4.0 is to maintain excellent HAZ toughness and filed weldability. The attached Figure 1 in **Exhibit A** provides comparative test data showing a relationship between the tensile strength (TS) and the P value of the steels in US '396 in comparison with the tensile strength and the P value of the present inventive steel. As it is shown in the Figure, the steels in US '396 do not satisfy the characteristic features of the present invention, e.g. having TS: 880-1080 MPa and a P value of 2.5-4.0. It is known that steels with high P value exhibits high tensile strength, thus, the steels disclosed in US '396 have low tensile strength.

For at least the above reasons, one of ordinary skill in the art following the disclosure of US '396 would not have obtained the claimed steel plate for ultra-high-strength linepipe having excellent low-temperature toughness of the present invention.

As discussed previously in the Amendments filed on January 8, 2009 and August 13, 2009, CA '439 does not disclose or suggest obtaining a degenerate upper bainite structure

and the production process according to the present invention. In particular, CA '439 describes a steel having a microstructure mainly composed of bainite and martensite, and to control the amount of bainite, martensite, or bainite and martensite dominant structure in the range from 90 to 100% in terms of a bainite and martensite fraction but does not disclose or suggest that the microstructure is composed of more than 70% of degenerate upper bainite. As discussed previously, the present invention utilizes degenerate upper bainite for balancing the HAZ portion of the linepipe at the weld site with a longitudinal direction strength of the linepipe mother material, and lowering a longitudinal direction strength against a peripheral direction strength. These effects cannot be attained by the martensite-bainite structure described in CA '439. Therefore, CA '439 provides no reason for one of ordinary skill in the art to seek the presently claimed steel product or method for its production.

Accordingly, the rejection of claims 1-28 under 35 U.S.C. §103(a) as obvious over US '396 in view of CA '439 cannot stand, and should be withdrawn.

Claims 1-22 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,634,988 to Kurebayashi, et al. ("US '988") in view of CA 2,429,439 ("CA '439") for the reasons stated in the previous office action dated March 13, 2009 and June 23, 2009.

As acknowledged by the Examiner in the Office Action (on page 5) dated September 9, 2009, Applicant's newly submitted claims 23 to 28 in the Amendment filed on August 13, 2009, which recite steel containing not more than 0.28% Si or no Si would patentably distinguish over steel of US '988 containing 0.6 to 2.0% of Si. The remaining claims have been amended to incorporate the subject matter of the canceled claims 23, 25, and 27, more specifically, to recite that the steel plate for ultra-high-strength linepipe having excellent low-temperature toughness has not more than 0.28 mass% of Si.

As discussed above, CA '439 describes a steel having a microstructure mainly composed of bainite and martensite but does not disclose or suggest that the microstructure is composed of more than 70% of degenerate upper bainite, therefore, the rejection of claims 1-22 under 35 U.S.C. § 103(a) over US '988 in view of CA '439 cannot stand and Applicants respectfully request withdrawal of the rejection.

In view of the foregoing amendments and remarks, Applicants respectfully submit that the present application is in condition for allowance. Early and favorable action by the Examiner is earnestly solicited. If the Examiner believes that issues may be resolved by a

telephone interview, the Examiner is invited to telephone the undersigned at the number below.

Respectfully Submitted,

Date: December 8, 2009

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Enclosure: Exhibit A

EXHIBIT A